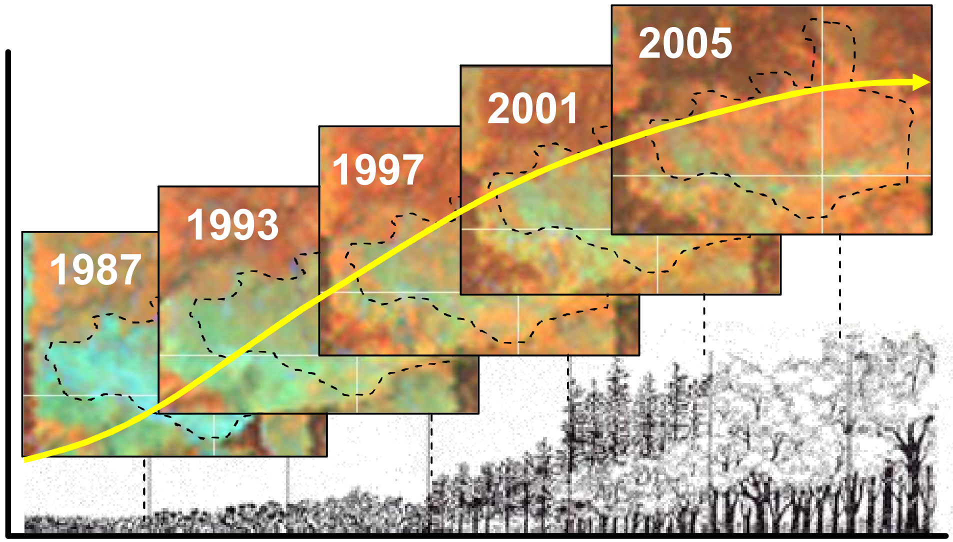
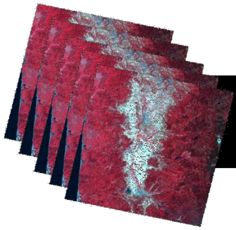
Trajectory Applications with Landsat



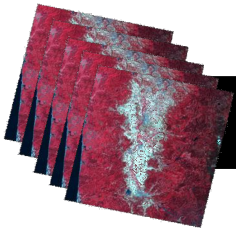
Todd A. Schroeder
Integrated Remote Sensing Studio
Department of Forest Resources Management
University of British Columbia



Objectives :

- Why trajectories?
- Two examples

1. Post-harvest forest regrowth rates – western OR
2. Mt. Pine Beetle Infestation – British Columbia



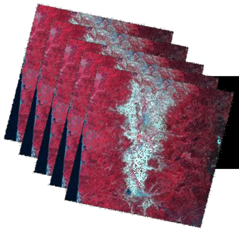
Why?

- Forest change is often a long term process which can be non-linear in nature.
- Multiple images are required to accurately characterize processes like time of disturbance, rate of regrowth and gradual mortality from insect infestation.
- Given long term record, Landsat is a logical choice for trajectory analysis.

3 advantages to using trajectories for vegetation change…….

1. Spectral variations from atmosphere and phenology are minimized.
2. Trajectory curves can be statistically compared using longitudinal analysis.
3. Trajectories can be quantified through parameterization of the fitted mean curve (e.g., delay, time to canopy closure, maximum growth rate).

- Success hinges on successful radiometric calibration



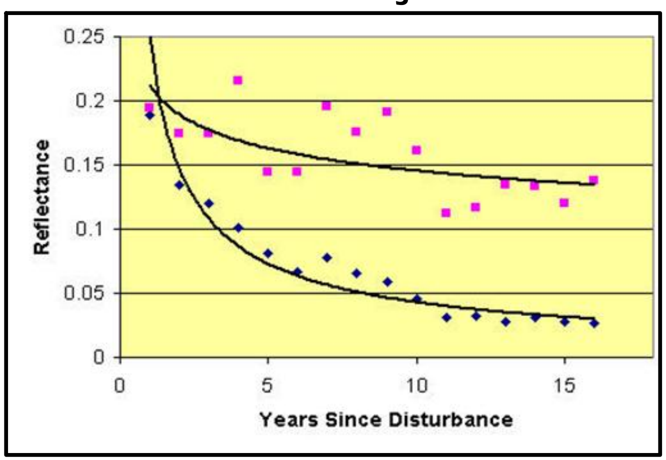
Radiometric Calibration :

- "Absolute-normalization" approach – Multivariate Alteration Detection (MAD)
- Based on CCA – invariant to linear scaling (gain/bias, clouds)
- Equally accurate as band-wise regression with hand-selected PIFs
- Normalization most important step

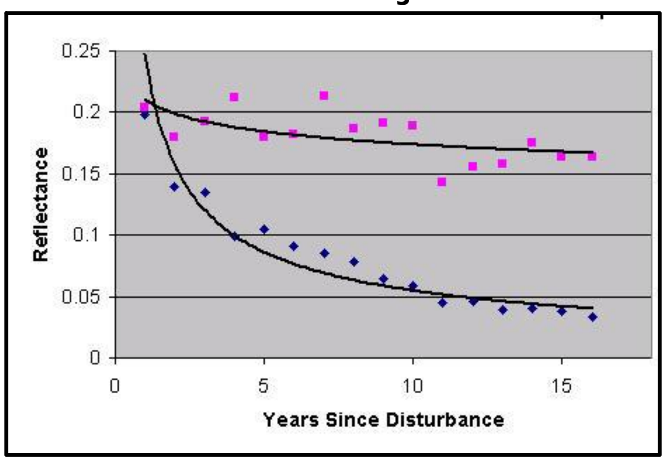
= Slow

= Fast

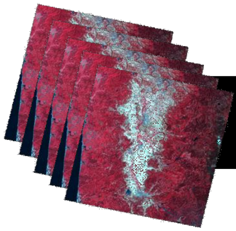
Uncalibrated Trajectories



Calibrated Trajectories



- Schroeder et al., (2006). Radiometric calibration of Landsat data for characterization of early forest successional patterns in western Oregon. *Remote Sensing of Environment. 103, 16-26.*



Study Area :

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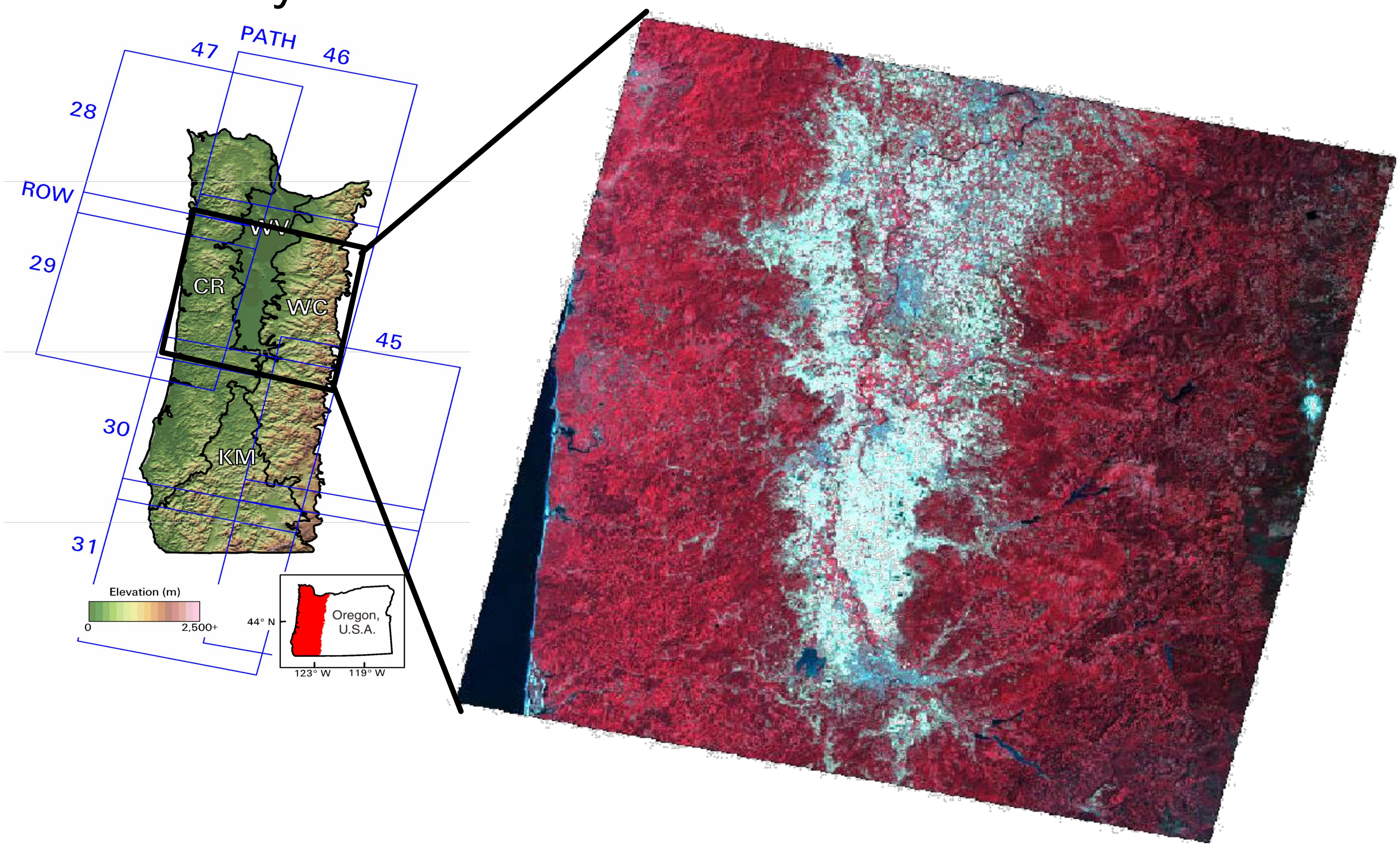

Data Cube:

Sensor	Date
TM	8/26/1986
TM	7/12/1987
TM	8/31/1988
TM	9/3/1989
TM	7/7/1991
TM	8/10/1992
TM	8/29/1993
TM	7/31/1994
TM	8/19/1995
TM	8/21/1996
TM	7/23/1997
TM	8/11/1998
TM	8/16/2000
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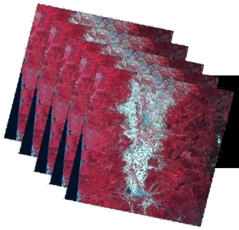
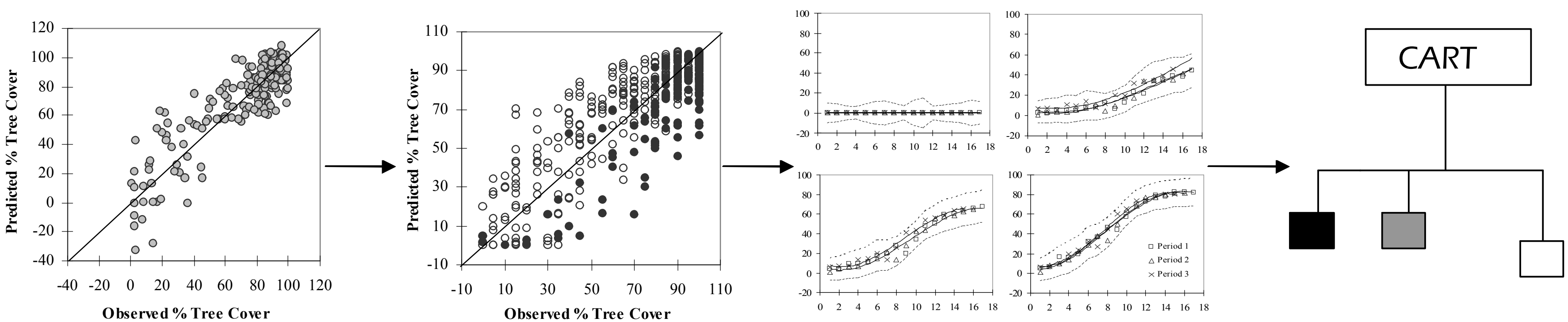
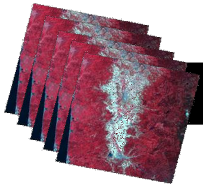
ETM+	7/29/2002



Forest Regrowth Modeling :

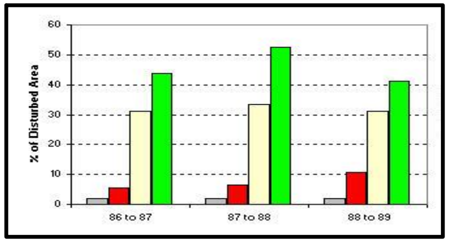
1. Image Normalization
2. Build Initial Regression Model – % Tree Cover
3. Extrapolate initial model to normalized images
4. Temporal accuracy assessment – PI data
5. Map clearcuts (3 periods)
6. Spatially group pixels that have similar trajectories (ISODATA Clustering)
7. Describe variation in regrowth trajectory classes using CART modeling

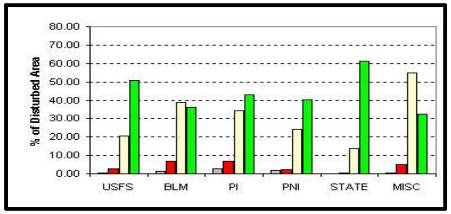


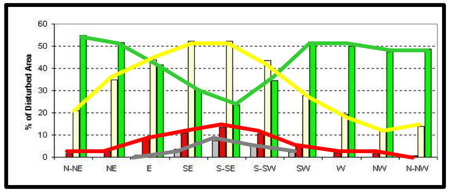


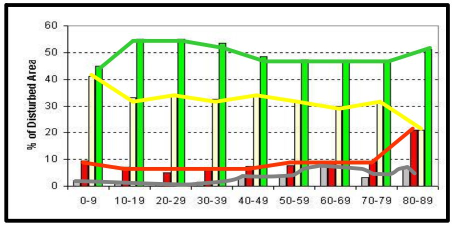
Results :

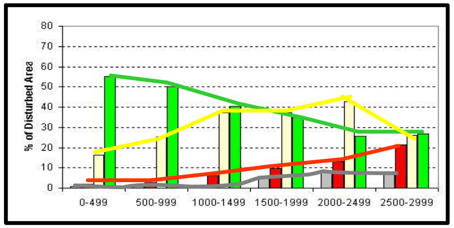
CRP



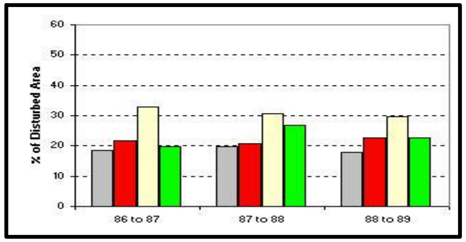


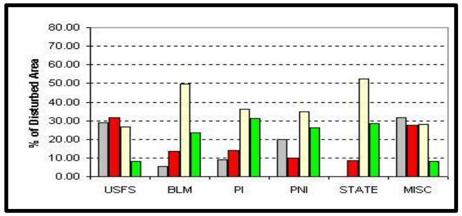


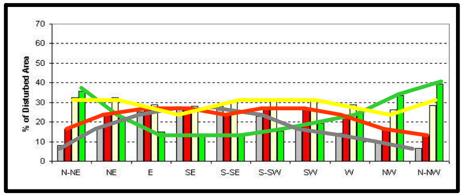


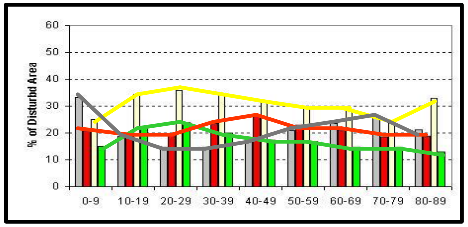


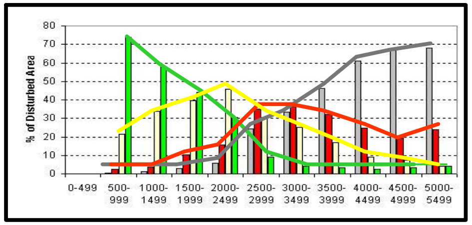
WCP











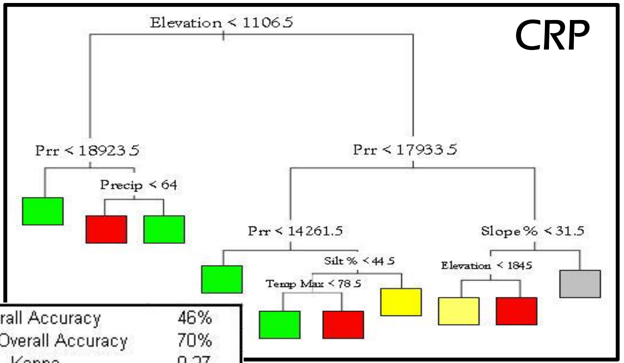
% of Disturbed Area

Ownership

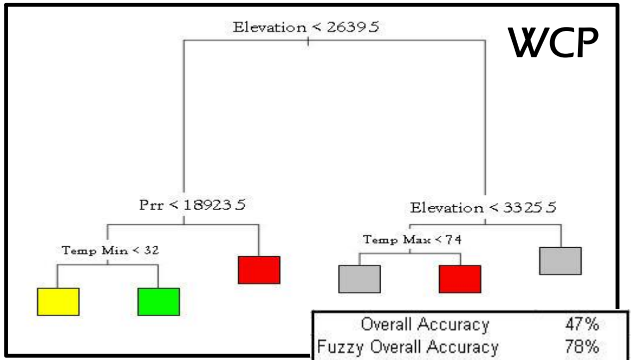
Aspect

Slope

Elevation



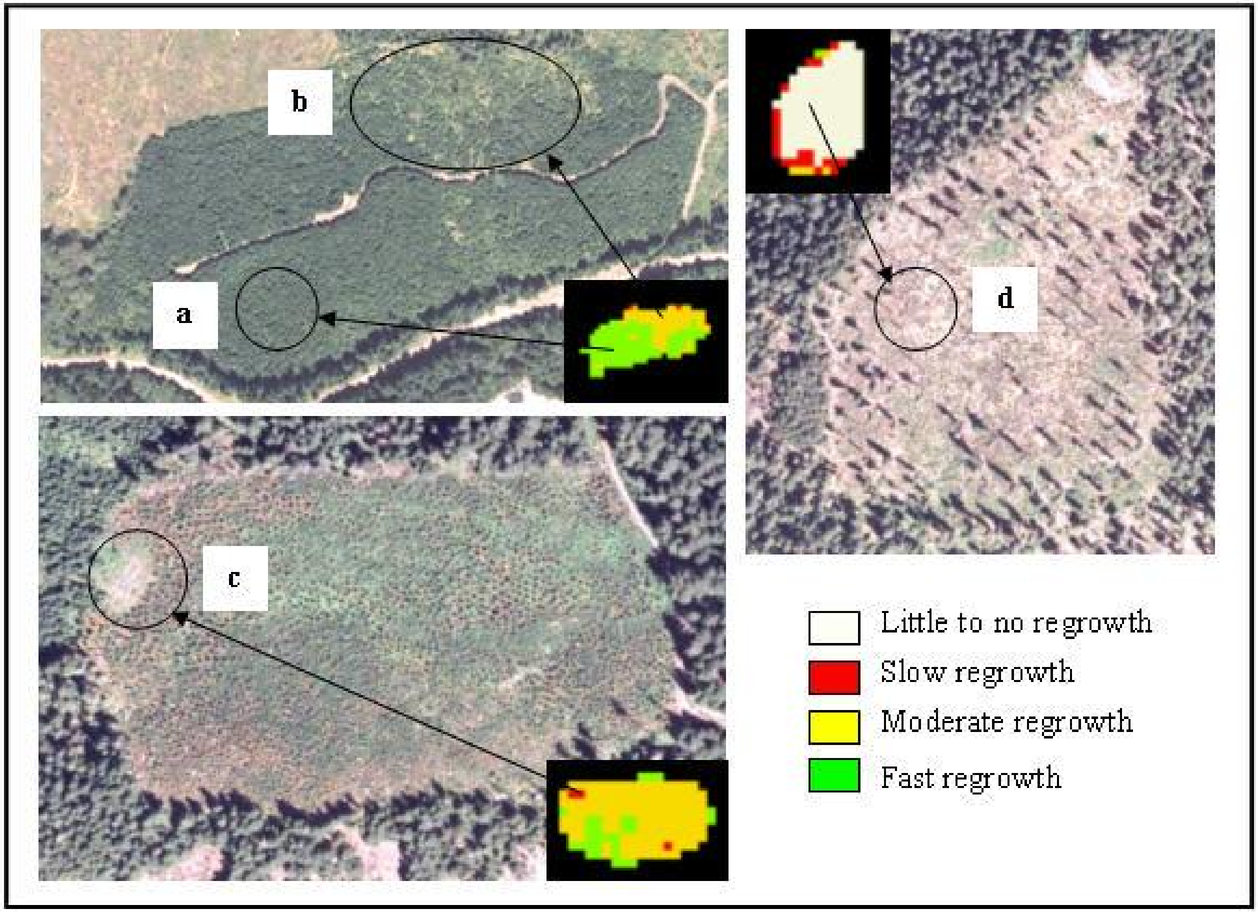
Overall Accuracy	46%
Fuzzy Overall Accuracy	70%
Kappa	0.27



Overall Accuracy	47%
Fuzzy Overall Accuracy	78%
Kappa	0.29

- Little to No Recovery
- Slow Recovery
- Moderate Recovery
- Fast Recovery

Forest Regrowth Maps :

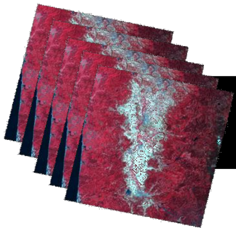


a. Rapid canopy closure

b. Hardwood competition

c. Logging damage (landing)

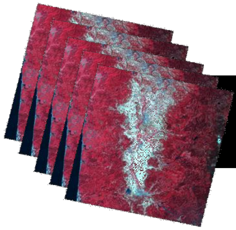
d. Delayed succession



Significant Findings :

- Photointerpreted tree cover has unavoidable interpreter bias (especially in the 30-60% cover range).
- Date-invariant regression improves on post-classification comparison technique through use of robust radiometric calibration technique, use of continuous (as opposed to class based) variables, and basing change on trajectory classes.
- Observed (re-confirmed) variable rates of post-harvest forest succession in western OR
- Extended forest regrowth trajectories from PI space to Landsat spectral space.
- CART modeling yielded ecologically interpretable results.
- Confirmed importance of plant relevant predictor variables – PRR.

- Schroeder et al., (2007). Patterns of forest regrowth following clearcutting as determined from a Landsat time-series. *Forest Ecology and Management.*



Mountain Pine Beetle :

- Objective is to accurately map year of stand death, as well as better understand pre- and post-infestation forest characteristics.
- Data cube is required as Mt. pine beetle attack can vary from severe to gradual and is a multi-staged process (green vs. red attack).